NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA

THESIS

AN ANALYSIS OF CONTAINERIZATION OF AMMUNITION EFFORTS IN THE REPUBLIC OF KOREA AND THE UNITED STATES

by

Chong K. Kim

March, 1996

Thesis Advisor: Keebom Kang

Thesis
K41415

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE March 1996	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE AN ANALYSIS OF CONTAINERIZATION OF AMMUNITION EFFORTS IN THE REPUBLIC OF KOREA AND THE UNITED STATES	5. FUNDING NUMBERS
6. AUTHOR(S) Kim, Chong K.	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.	12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

This thesis examines the current and the future efforts to modernize ammunition handling capability in the Republic of Korea and the United States. It describes how these improvement programs will enhance the current capability of Chinhae, Korea and Concord, California, the proposed containerized ammunition handling ports of the two countries, to ensure success of the Major Regional Conflict-West (MRC-W) scenario as outlined in the Mobility Requirements Study (MRS) 1992. Also, various containerized ammunition related issues such as the lessons learned from TURBO Containerized Ammunition Distribution System (CADS) Exercise 1994 and Desert Storm/Desert Shield are discussed.

14. SUBJECT TERMS Ammunition Containerization Efforts in the Republic of Korea and the United States	15. NUMBER OF PAGES 72
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18 298-102

Approved for public release; distribution is unlimited.

AN ANALYSIS OF CONTAINERIZATION OF AMMUNITION EFFORTS IN THE REPUBLIC OF KOREA AND THE UNITED STATES

Chong K. Kim
Lieutenant, United States Navy
B.A., University of Rochester, 1988

Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN SYSTEMS MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 1996

DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY CA 93943-5101

ABSTRACT

This thesis examines the current and the future efforts to modernize ammunition handling capability in the Republic of Korea and the United States. It describes how these improvement programs will enhance the current capability of Chinhae, Korea and Concord, California, the proposed containerized ammunition handling ports of the two countries, to ensure success of the Major Regional Conflict-West (MRC-W) scenario as outlined in the Mobility Requirements Study (MRS)1992. Also, various containerized ammunition related issues such as the lessons learned from TURBO Containerized Ammunition Distribution System (CADS) Exercise 1994 and Desert Storm/Desert Shield are discussed.

TABLE OF CONTENTS

I. INTRODUCTION 1

A. PROBLEM STATEMENT 1

B. ADVANTAGES OF CONTAINERIZED SHIPPING OF AMMUNITION. 2

C. SCOPE OF THESIS 3

D. THESIS QUESTIONS 4

E. THESIS STRUCTURE 4

II. BACKGROUND 7

A. INTRODUCTION 7

B. MOBILITY REQUIREMENTS STUDY (MRS) 7

C. TURBO CONTAINERIZED AMMUNTION DISTRIBUTION SYSTEM (CADS) 1994. 9

1. Purpose 9

2. Background 10

3. Concept of Operations. 10

4. Objectives 11

5. Lessons Learned 11

D. AMMUNITION CONTAINERS. 13

1. MILVAN - Ammunition Restraint 13

2. 20 - Foot ISO End-Opening Container 13

3. 20 - Foot ISO Side-Opening Container 14

4. 20 - Foot ISO Half-Height Container 14

5. 20 - Foot Flatracks 15

6. Load and Roll Pallet (LRP) 15

E. AMMUNITION CONTAINERIZATION PROGRAM 15

F. AMMUNITION MOVEMENTS DURING

DESERT STORM/ DESERT SHIELD 16

G. VULNERABILITY OF READY RESERVE FORCE READINESS 18

H. SUMMARY 19

III. CONTAINERIZATION OF AMMUNITION EFFORTS IN THE ROK . 21

A. INTRODUCTION 21

B. CHINHAE AMMUNITION PIER 21

1. History 21

2. Location and Facility 21

3. Organization 22

C. DISCUSSION 22

D. ISSUES 24

1. Pier Construction Requirements 24

2. Cargo Handling Requirements 25

3. Ammunition Holding Facility Requirements 26

E. SUMMARY 27

IV. CONTAINERIZATION OF AMMUNITION EFFORTS IN THE U.S. . 29

A. INTRODUCTION 29

B. CONCORD WEAPONS STATION 29

1. History 29

2. Location 30

3. Mission 30

4. Facility. 31

C. DISCUSSION 32

D. ISSUES 34

E. COST/BENEFIT ANALYSIS. 37

F. SUMMARY 40

V. CONCLUSIONS AND RECOMMENDATIONS 41

APPENDIX A. LIST OF ACRONYMS 43

APPENDIX B. MAP OF CHINHAE AMMUNITION PIER 45

APPENDIX C. GANTRY CRANES 47

APPENDIX D. CONTAINER HANDLING EQUIPMENT 49

APPENDIX E. YARD TRACTORS 51

APPENDIX F. IMPROVEMENT SPECIFICATIONS, CHINHAE AMMUNITION PIER 53

APPENDIX G. MAP OF NAVAL WEAPONS STATION CONCORD. . 55

APPENDIX H. NAVAL WEAPONS STATION CONCORD PIERS . . 57

LIST OF REFERENCES. 59

INITIAL DISTRIBUTION LIST 61

I. INTRODUCTION

A. PROBLEM STATEMENT

Over twenty years ago the commercial maritime industry began replacing breakbulk cargo operations with the more efficient intermodal containerization system. As the use of containers increased, so did the number of container vessels. Today, container vessels have effectively replaced the breakbulk ship. This change in the composition of the commercial maritime industry is forcing a reevaluation of United States strategic lift doctrine.

Prior to Operations Desert Shield and Desert Storm, strategic planners relied on breakbulk ships to support deployed forces. Mobilization was seldom an issue as there was an ample reserve of these types of vessels. Additionally, the commercial maritime industry was capable of augmenting any deficiency in sealift capability. However, today, the availability of breakbulk ships in ready reserve force is diminishing as they are deteriorating with age. Despite the drastic decline in available breakbulk ships, the military continues to lift ammunition via this platform. This practice is primarily due to the lack of container handing capability at ammunition facilities around the world. Indeed, recent military exercises and contingencies, e.g., Operations Desert Shield and Desert Storm, would have benefited from the ability to use containerized shipment of ammunition.

Presently, the Military Ocean Terminal at Sunny Point, North Carolina (MOTSU) is the only CONUS ammunition port facility with the throughput capacity required to support future major regional conflicts as outlined in the 1992 Mobility Requirements Study (MRS). Presently, MOTSU maintains 87% of the total ammunition handling

capability in CONUS. The MRS indicated that improvement of the West Coast ammunition handling capability is necessary to achieve a more balanced strategic capability. However, output capability at CONUS ports of embarkation (POE) is only one part of the problem facing strategic planners. If the goal of complete containerized shipments of ammunition is to be achieved, ports of debarkation (POD) must have comparable capability.

The United States military presence in the Republic of Korea (ROK) currently stands at approximately 35,000 personnel. Ammunition required to support these forces arrives at one port of entry, Chinhae. The port facility currently receives ammunition via breakbulk cargo ships. Because of the use of breakbulk which requires greater onload and offload time, Chinhae is subsequently unable to provide the throughput capacity required to support a military contingency in the region. This thesis will primarily examine what initiative are currently being taken and should be taken in the future to modernize the existing facilities in the ROK and the U.S. in order to handle the necessary throughput capacity in this region.

B. ADVANTAGES OF CONTAINERIZED SHIPPING OF AMMUNITION

Presently, most U.S. military ammunition operations employ breakbulk transport methods. The breakbulk process involves loading cargo into the open hold of a general breakbulk cargo ship. The cargo holds of these ships are partitioned by decks and vertical bulkheads, providing open areas for cargo storage. Cargo is lowered into the hold by a crane and is then positioned to facilitate additional stowage. The ammunition is usually

divided into pallet sized loads. This is a time consuming process which requires large amounts of dunnage (wood supports) to brace the cargo and prevent movement.

Prior to loading ammunition into a breakbulk cargo hold, the area must be prepared with a layer of sheathing to prevent any metal-to-metal contact by the munitions. As each layer is completed, another layer of dunnage is placed around the pallet to support the load and to prevent contact with other weapons.

Containerizing ammunition eliminates the slow, inefficient and tedious method described above. Pre-stuffed containers arrive at POEs where they are staged or loaded onto container ships. The storage capacity of container vessels is vastly superior to that of breakbulk ships. Data obtained from the MRS indicates that container ships have about 2.6 times the capacity of breakbulk ships. Additionally, the on/offload time decreases approximately 75% when container ships are employed.

C. SCOPE OF THESIS

The study will be divided into three major parts. First, current and future efforts to upgrade existing ammunition facility of Chinhae, ROK will be examined. Second, emphasis will be placed on the future modernization of the ammunition facility in Concord, CA and how this project along with the project in Korea can better meet the requirements mandated by the Major Regional Conflict-West (MRC-W) scenario. Third, the outcomes of the recent Turbo Containerized Ammunition Distribution System (CADS) military exercise as well as other containerization related issues will be reviewed to gain further insight in the DoD efforts to improve containerized ammunition distribution.

D. THESIS QUESTIONS

The primary questions addressed by this thesis are:

1) How can the current ammunition handling facilities of Chinhae and Concord be modernized to support MRC-W scenario; what is currently being done and what will be the benefits of these modernized facilities?

The secondary questions addressed by this thesis are:

2) How did containerization of ammunition come about?

3) What are shipboard methods of transportation of ammunition in the past and present?

4) What is the 1992 Mobility Requirements Study and its significance?

5) How can lessons learned from recent Turbo Containerized Ammunition Distribution System Exercise be applied to improve future ammunition distribution system?

6) What are the different types of ammunition containers that are currently in the DoD inventory?

7) How extensively was containerization utilized in sealift operations during Operations Desert Shield and Desert Storm?

8) What is the current status and capability of DoD sealift and commercial maritime assets as related to containerization of ammunition in the U.S.?

9) What materials and equipment are necessary to fully modernize and operate a containerized ammunition handling facility?

E. THESIS STRUCTURE

This thesis is presented in five chapters. Chapter I serves as an introduction to the research issues. Chapter II gives the reader background on the various issues that are relevant to containerized ammunition. Chapter III discusses the current containerized ammunition efforts in the ROK as pertinent to the modernization of Chinhae Ammunition

Pier. In Chapter IV, containerized ammunition efforts in the U.S are discussed, focusing on the proposal to modernize Naval Weapons Station Concord and potential cost savings through these efforts. Chapter V summarizes the thesis research findings and also makes recommendations to DoD on the benefits of containerized ammunition efforts in the ROK and the U.S.

II. BACKGROUND

A. INTRODUCTION

This chapter highlights various issues that are relevant to ammunition containerization to gain further insight into DoD efforts to improve ammunition containerization and distribution. First, it describes the significance of the Mobility Requirements Study. Second, the lessons learned from the United States Transportation Command sponsored TURBO Containerized Ammunition Distribution System Exercise and Desert Shield/Desert Storm and the vulnerability of Ready Reserve Force readiness are discussed in regard to their implications for the logistics of ammunition handling.

B. MOBILITY REQUIREMENTS STUDY (MRS)

In the Fiscal Year 1991 National Defense Authorization Act, Congress tasked the Department of Defense (DoD) with conducting a study of the military's future mobility requirements. This study was headed by the Director for Force Structure, Resources and Assessment (J-8) of the Joint Chiefs of Staff. In January 1992, the Director, J-8, along with the Advisory Group and Coordinating Committee, issued their expectations and recommendations as the Mobility Requirements Study (MRS). One of the primary areas focused by this study was strategic mobility, the ability to transport sufficient quantities of men and material in support of military contingency abroad. The MRS provided a detailed analysis of the existing military transportation infrastructure in an effort to determine requirements of the Armed Services for future military contingencies. The study outlined three scenarios, two separate major regional conflicts, and two near simultaneous major

regional conflicts (MRCs). The scenarios were designated MRC-East, MRC-West, and MRC-East and West. Data obtained from the experiences and statistics of Operations Desert Shield/ Storm was used as a baseline for the analysis. [Ref.1:p. ES-1]

Pertaining to ammunition distribution, the MRS indicated that the capability to move ammunition was not adequate to meet scenario throughput requirements. [Ref.1:p. E-I-5] The insufficient output capacity of CONUS facilities presented a risk to deployed forces. The Gulf War experience revealed that there were only three facilities capable of ammunition distribution. The three facilities were MOTSU, and Naval Weapons Stations in Earle, New Jersey and Concord, California. Currently, MOTSU is the only facility with significant ammunition handling capability, breakbulk or container. Recommendations of MRS included:

> (1) integration of containerization as the primary mode of ammunition transportation and
>
> (2) upgrade of existing facilities to appropriate output levels and the establishment of a West Coast container facility.

Recommendation one would make ammunition distribution more efficient, reducing the risk of undersupply to deployed forces in a contingency. Recommendation two would be required if the benefit of containerization was to be realized. Hence, upgrading the Concord facility would provide a West Coast capability to handle large amounts of containerized ammunition and decentralize the national ammunition output capacity. As a result, upgrading Concord would allow the U.S. to distribute ammunition more rapidly to the Western Pacific as well as Indian Ocean areas.

The MRS stated that CONUS based ammunition requirements to support a major regional conflict vary between 294,182 STONS and 478,000 STONS. Currently MOTSU can load 8,700 STONS (600 TEUs) per day, matching Chinhae's future anticipated offload capability. However due to the distance of these two ports, shipments would be in transit for at least 16 days by a container vessel, significantly increasing the risk to deployed forces in a contingency. On the other hand, linking Chinhae to Concord can potentially save approximately 5 days. This is why the MRS has identified a West Coast ammunition container port at Concord as a solution.

C. TURBO CONTAINERIZED AMMUNITION DISTRIBUTION SYSTEM (CADS) 1994

1. Purpose

Conducted from 1 Aug. to 27 Nov. 1994, TURBO CADS 1994 was United States Transportation Command (USTRANSCOM) sponsored joint exercise in the Pacific designed to test the effectiveness of ammunition shipment through intermodalism. Simply put, intermodalism is a method of a material shipment in containers that integrates rail, highway, and water modes of transportation to provide door-to-door service.

USTRANSCOM's goal was to promote an effective and efficient intermodal container transportation system by increasing DoD's use of intermodal systems, ensuring interoperability between DoD and commercial systems and maximum use of intermodal assets and infrastructure. [Ref. 2:p. 10]

2. Background

The Containerized Ammunition Distribution System (CADS) has been successfully implemented in the European theater in the recent years. Shipments from CONUS ammunition plants and depots have been routinely transported to Germany via Internation Standards Organization (ISO) containers. This has been possible due to adequate container handling infrastructure at POEs and PODs. The success of the intermodal operation in the European theater warranted a review of other export ammunition shipments to determine the validity and applicability of container delivery to various sites in the Pacific theater.

On 19 November 1993, the United States Commander in Chief Pacific (USCINCPAC) established a munitions containerization working group. This group became responsible to develop a time-phased action plan leading to institutionalizing containerized ammunition shipments in the Pacific region. After several meetings, it was determined that there was a definite need to demonstrate the alternatives to breakbulk and to push the worldwide ammunition logistics system to modernization because the present munitions delivery system relied too heavily on breakbulk movement of munitions. [Ref. 3:p.1]

3. Concept of Operations

The overall concept of TURBO CADS 1994 was to conduct an intermodal shipment of munitions from multiple CONUS origins to multiple United States Pacific Command (USPACOM) destinations. First, containerized ammunition was moved from eight different ammunition depots in the U.S. to NWS Concord, CA and Port Hadlock,

WA, POEs. From these POEs, the containerized ammunitions were moved to their respective destinations in Guam, Japan, and ROK by SS Gem state, a craneship from the Ready Reserve Fleet (RRF) and by MV Green wave, a MSC charted vessel, both self-sustaining containerships. Approximately 1150 TEUs were transported during the exercise. [Ref. 3:p. 2]

4. Objectives

TURBO CADS 1994 had several objectives including:

1) Evaluate on-hand CHE, and identify other equipment shortages

2) Identify shortfalls in the transportation system that could prevent the routine continuous use of containerized munitions

3) Demonstrate the usefulness and ease of use of blocking and bracing improvements compared to breakbulk.

4) Observe inland rail movement of containerized munitions to designated unstuffing locations in Korea.

5) Observe containerized munitions transfer operations at various inland locations.

6) Assist in the development of container doctrine as well as hardware requirements and applications of CADS doctrine.

7) Exercise NWS Concords container throughput capability. [Ref. 3:p.3]

5. Lessons Learned

As stated in the USTRANCOM's TURBO CADS 1994 After Action Report, "the exercise provided a unique opportunity to test specific USPACOM units' capability to deliver/receive munitions in containers; to educate munitions requisitioners relative to their capability to order munitions and develop the requirement for containerized munitions delivery; and to document improvements and weaknesses within USPACOM for

munitions movements and handling efficiency, and overall increased throughput capability." [Ref. 3:p. 5]

Overall, the exercise effectively executed its objectives and proved to be quite successful without major problems. However, one area of significant concern that became obvious throughout the exercise was the lack of container handling equipment (CHEs). The problem ranged from few quantities at some locations to none at other locations. It was noted in the after action report that at some locations, CHEs were borrowed from other DoD activities, while other locations had to lease the equipment. The report also pointed out that the prospect was even worse in OCONUS. Based on the provided information, it is quite obvious that the lack of CHEs could have a detrimental effect on large scale container operations. In order to effectively handle the container flow, each location should have had at least two CHEs during the exercise.

Most ports in the Pacific arena are not built with shoreside cranes designed to conduct heavy-lift container operation, and therefore, vessel selection for the exercise was restricted to ships that can load and offload themselves without a crane mounted on the pier. Therefore, it was also recommended in the after action report that self-sustaining containership should continue to be utilized for future exercises or that portable cranes be placed on non-self sustaining containerships. The above recommendation is not only relevant in the case of Chinhae but also at NWS Concord, which demonstrated the need to invest in CHEs as well. Until both facilities are fully equipped with modern container handling capability, it is evident that ammunition shipment through intermodalism won't be fully optimized. The container throughput capability at these facilities are highly

dependent on the future infrastructure improvements at these sites and thus, future TURBO CADS exercises with similar scope will result in higher container throughput only when these facilities are fully modernized. Additionally, there will be a greater potential for interoperability between DoD and commercial systems through the future infrastructure improvement in at these facilities.

D. AMMUNITION CONTAINERS

The DoD has a variety of containers and handling equipment intended to be used during a mobilization of forces. This section will examine the various types of containers that are currently in the DoD inventory which are utilized for the movement of ammunition.

1. MILVAN - Ammunition Restraint

The MILVAN is a specially designed container developed specifically to carry ammunition. The MILVAN has an internal restraint system that is made up of rails permanently installed along the sides of the container and adjustable crossbars designed to keep the ammunition from moving inside the container. Most MILVAN are 8-feet wide, 8-feet high and 10-feet long, however some have been procured that are 8.5-feet high. Both MILVAN sizes also meet Internation Standards Organization (ISO) requirements. [Ref. 4:p. 3]

2. 20-Foot ISO End - Opening Container

These containers are standard 8-feet wide, 8-feet high, 20 feet long container used in the commercial industry with one modification. The door and cornerposts have been modified with angle iron to enhance blocking and bracing required for ammunition, to

allow wooden dunnage to be used without distributing the force to the door. These containers also have standard handling fittings on the top of the container as well as forklift pockets along the bottom. [Ref. 4:p. 7]

The end-opening container will probably be the cornerstone of the DoD's general container system. It is currently the standard throughout the commercial industry and, as such, is the most familiar to those involved in stuffing and unstuffing containers.

3. 20-Foot ISO Side - Opening Container

These containers are similar to the 20-foot ISO end-opening container with one exception. They have two double doors located on the side of the container instead of a door at one end. These containers provide easy access to their contents by a forklift, and they also are fitted with internal tie down rings for securing ammunition. [Ref. 4:p. 13]

Side-Opening Containers provide a unique way to unstuff the container. It is easy for almost any forklift to reach the cargo inside. Therefore, it is used very successfully with many types of ammunition.

4. 20-Foot Half-Height Container

These containers are 8-feet wide and 20-feet long, however they have only 4-feet 3-inches in height. They have fixed sides and one and drops down to allow easy access by a forklift. Although there is no top on the container, bows and tarpaulins are provided to cover the contents. These containers are used for extremely heavy ammunition that does not take up very much space. Therefore, these containers are extremely useful for maximum utilization of space when transporting very heavy ammunition. [Ref. 4:p. 17]

5. 20-Foot Flatracks

A flatrack is a shipping platform with endwalls and no top or sides. Flatracks used for ammunition shipments are 8-feet wide, 8-feet high and 20-feet long with container handling fittings and forklift pockets. Flatracks are used to transport high cube munitions. [Ref. 4:p. 35]

The flatrack is the least desirable type of container to use with ammunition because it does not provide much security for the ammunition.

6. Load and Roll Pallet (LRP)

The LRP is a steel frame platform designed to fit inside a standard 20-foot ISO container. One end of the platform is fitted with rollers. To move the platform, the end without the roller is lifted by a forklift, or perhaps a truck with a winch, and the load can then be rolled into or out of a container. This system is primarily used for transporting missiles. [Ref. 4:p. 39]

E. AMMUNITION CONTAINERIZATION PROGRAM

Prior to and during Desert Storm/Desert Shield, the MILVAN-Ammunition Restraint was the primary ammunition container. Because the majority of munitions were transported by breakbulk methods during the Gulf Conflict, the need for additional containers was not realized until retrograde operations began. Hence the MSC procured a variety of 20 foot containers from commercial sources to support the retrograde program. The six types of containers previously mentioned are maintained in the DoD inventory but they lack in the number needed to meet the needs of future major contingencies. Yet, there are no current plans for additional procurement.

DoD Directive 4500.37, Management Of The DoD Intermodal Container System, clearly states that containerization is the preferred method of ammunition shipment. The services are required to maintain a container capability to meet contingency throughput requirements. [Ref. 5] However, in spite of DoD policy and the findings of MRS, today, not enough emphasis is placed on expanding DoD inventory of ammunition containers as evidenced in the lessons learned from TURBO CADS. If sufficient number of ammunition containers are prestaged at various ammunition handling facilities, the military will certainly be able to respond faster to hostile threats during a contingency.

F. AMMUNITION MOVEMENTS DURING DESERT STORM/DESERT SHIELD

When Iraqi army invaded Kuwait in August of 1990, the U.S. military responded superbly. The ability of logisticians to move massive amounts of personnel and material into the region was the key to the success of Operations Desert Shield /Desert Storm. The effort included movement of over 500,000 personnel and 7 million tons of equipment by the end of the conflict. However, the use of containers in sealift operations accounted for only 20 percent of the total material moved. [Ref. 6:p. 25]

The conflict was the first time the U.S. military deployed its forces overseas since the commercial maritime industry switched to the container ship as the primary ship type. In the past, the military had no problem getting breakbulk ships from the commercial industry to move its cargo. However, this was not the case for Desert Shield/Desert Storm. Military Sealift Command (MSC) ended up chartering many Roll-on/Roll-off (Ro/Ro) or breakbulk ships because the military was not adapted to take full advantage of

containerization. Although some of what was shipped went by containerization, of 300,000 tons of ammunition shipped, only five percent was containerized. [Ref. 7:p. 21] Although containerization of ammunition had previously been recognized as more efficient than the breakbulk method, the containerization infrastructure was not prepared to implement the process.

Hence, through the use of breakbulk ships, ammunition shipments arrived approximately 42 days after the initial surge movement to the Gulf. [Ref. 8:p. 20] As previously mentioned, the sheathing requirement for a breakbulk ship prior to loading ammunition is a long and tedious process and it significantly slows down the movement of a breakbulk ship when compared to a container vessel.

Along with the reasons stated above, the bottom line reasons for the lack of containerizing ammunition were as follows:

1) Limited availability of ammunition suitable containers

2) Lack of west coast containerized ammunition capability

3) Lack of container handling equipment at the units in the field and PODs. [Ref. 9:p. 49]

There also is one other factor that hindered containerizing ammunition. During the sustainment phase of the conflict, the majority of military material shipped to the Gulf was transported on commercially flagged vessels under the terms of the Special Middle East Shipping (SMES) Agreement. This agreement, between the MSC and chartered commercial carriers, provided only for regular shipment of general military cargo. The agreement did not include provisions for ammunition. As a result, ammunition had to be

transported by Fast Sealift Ship (FSS), Ready Reserve Force (RRF) ships or chartered vessels. [Ref. 10:p. 2]

G. VULNERABILITY OF READY RESERVE FORCE (RRF) READINESS

Established in 1976, the Ready Reserve Force (RRF) today consists of mostly former dry cargo and tanker vessels and are considered outmoded for commercial shipping because of container technology, automated diesel-powered propulsion, and cargo handling systems. The average ship in RRF is about 25 years old. [Ref. 11] These ships are managed by Maritime Administration (MARAD) which is a part of the Department of Transportation.

The breakbulk vessels, a form of a dry cargo vessel, that the military has in the RRF are slow to load/offload and are costly to operate because they are old. Additionally, declining numbers of merchant mariners as well as the skill levels required to operate these vessels, coupled with vessel maintenance problems, have become a real concern for future military sealift. Therefore, the breakbulk vessels are becoming more difficult to compete in today's fast-paced world and it is likely that few of them will be available for ammunition transport in the future.

During the Desert Storm/Desert Shield operation, the military did not activate RRF in its entirety, nevertheless, there were sailing delays due to lack of complete manning and this may have been one of the reasons why it took 42 days to deliver ammunition to the Gulf as previously noted. Unless the problems associated with managing the RRF can be corrected, the future of military sealift may remain vulnerable. As a way to counter the vulnerability of RRF readiness in the future, DoD should invest more efforts in the

utilization of container ships as its main source of transportation to the fullest extend possible.

H. SUMMARY

MRS stated the need for a west coast ammunition container port and recommended that NWS Concord should be the logical choice. It also stated that modernizing the ammunition handling facility at Chinhae along with Concord would significantly improve readiness in a likely event of MRC-W scenario. These two modernization efforts will be discussed further in the following chapters.

TURBO CADS Exercise provided a realistic challenge to test DoD's ability to incorporate intermodalism into its container distribution system in the Pacific theater. Although the exercise satisfactorily achieved its objectives, through the lessons learned, it is apparent that the lack of CHEs and containers will continue to limit DoD from taking a full advantage of intermodal transport. In order to be better equipped for future contingencies, DoD should procure additional CHEs and containers and establish programs to successfully respond to potential threats.

The Gulf conflict was a success in a macro sense, however, there were flaws in the ammunition transport due to limited availability of container equipment and facilities. If containerization can be fully implemented through all facets of sealift, the need to maintain the RRF should diminish and the problems associated with RRF maintenance and management could disappear as a result. Therefore, maintaining a fleet of containers and handling equipment instead of the aging RRF could prove to be much more cost effective in the future.

III. CONTAINERIZATION OF AMMUNITION EFFORTS IN ROK

A. INTRODUCTION

The U.S. established a plan to modernize the existing ammunition facility in Chinhae, Korea in 1992. When this project is completed, the modernized facility will be fully equipped to support a throughput capacity that will be necessary to support a military contingency in the region. This chapter will examine the status of the existing facility as well as the efforts which are currently being implemented to upgrade the existing facility. The present and future ammunition handling capability of the site will also be discussed.

B. CHINHAE AMMUNITION PIER

1. History

In the 27 September 1991 Journal of Commerce, VADM Donovan, then-Commander, Military Sealift Command, stated, "We were loading ammunition the same ways the Phoenicians were .... we have to make better use of containerized ammunition and ships." The VADM's comment is a good illustration of both the past and present ammunition handling ability in the ROK. Since the cessation of the Korean Conflict in 1953, the loading, unloading and transportation of ammunition via ships has not changed much at the Chinhae Ammunition Pier, the country's only designated peacetime ammunition handling facility.

2. Location and Facility

Chinhae is located on the southern coast of the ROK, about 45 miles west of Pusan (Appendix B), the country's principal seaport. The existing facility at the Chinhae

Ammunition Pier is approximately 600 feet long and 90 feet wide and the draft alongside the pier is about 30 feet deep. Two rail tracks extend the length of the pier which has deck strength of 600 pounds per square foot. [Ref. 12:p. 5] The existing infrastructure at Chinhae is not adequate to accommodate modern container ships.

3. Organization

The Chinhae Ammunition Pier is operated by the Port Operations Group (POG), a ROK Army transportation unit, the counterpart of the U.S. Military Traffic Management Command (MTMC). As a result of the U.S. and ROK Single Ammunition Logistics System Korea (SALS-K) host nation agreement, during all ammunition operations in Chinhae, POG and its contracted crew perform all stevedoring activities. Three teams of POG crew normally are assign to the port facility in two twelve-hour shifts. MTMC and other U.S. safety officials are present at the site during the operation and provide guidance and assistance in ensuring adherence to all loading, offloading, and handling doctrines. Once offloaded, the ammunition is distributed to various sites within Korea for the United States Forces Korea (USFK) use.

C. DISCUSSION

There have been various studies and recommendations to improve the ammunition transportation and handling operations. All share at least one common finding; containerization ensures more efficient and expeditious movement of ammunition. In addition to decrease transit and handling times, containerization reduces cargo damage liability during transit, which is an extremely important safety factor in ammunition transportation.

Currently, handling facilities at the Military Ocean Terminal at Sunny Point (MOTSU) have accounted for over 90% of ammunition shipments from the United States to Europe being containerized. To achieve this end in the Pacific arena, a meeting involving the U.S. Program Manager for Ammunition Logistics, the ROK Ministry of Defense Logistics Bureau, and the ROK Army Staff was initiated to discuss the possibility of modernizing the Chinhae Ammunition Pier. [Ref. 13]

Subsequent to this initial meeting, and upon request from both the ROK Ministry of Defense and the USFK, the Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) provided suggestions for incorporating a container handling facility in the Chinhae ammunition operation. Upon completion of the site survey by MTMCTEA engineers, two prototype design proposals were submitted to the ROK Ministry of Defense. One proposal recommended replacing the existing breakbulk facility with a new containerized facility. The other proposal outlined the prospect of supplementing the existing breakbulk facility with a co-located container handling facility providing dual ammunition handling capacity. The ROK Ministry of Defense chose the latter option for the following reasons:

1) The ROK deemed the cost of each proposal to be approximately equal.

2) The ROK favored the concept of having dual handling capability for it provides more versatility in ammunition handling operations. [Ref. 12:p. 1]

If in fact the cost of each proposal is equal, the choice of ROK Defense seems to be a logical one, since it will provide them with a capability to handle breakbulk as well as container ships.

D. ISSUES

The study submitted by MTMCTEA [Ref. 12] outlined the necessary technical requirements of the proposed facility at Chinhae. Three areas of concern were identified: 1) constructing a pier capable of accommodating modern container ships and their massive offload capability, 2) addition of cargo handling equipment, and 3) the construction of an ammunition holding facility.

1. Pier Construction Requirements

The study utilized the C9-M class, one of the largest modern container vessel, vessel as a guide for pier dimension requirements. A typical commercial C9-M vessel has the following characteristics: [Ref. 14]

Dead Weight	57,075 tons
Draft	38 ft
Overall Length	950 ft
Maximum Beam	106 ft
Capacity	3400 TEUs

A comparison of the C9-M vessel and the existing pier at Chinhae is shown in Table 1. The proposed pier is 75% longer and 30% deeper to accommodate C9-M vessels. Additionally, the pier will have a deck strength capable of handling a minimum of 1,000 pounds per square foot to support containers and container handling equipment (CHE).

Characteristics / Facility	Existing Pier	Proposed pier	C9-M class
Length	600 ft	1050 ft	950 ft
Width	90 ft	150 ft	106 ft
Draft	30.5 ft	40 ft	38 ft
Deck Strength	600 pd/sq ft	1000 pd/sq ft	N/A

Table 1. Present and Future Chinhae Ammunition Pier.
From Ref. [13]

2. Cargo Handling Requirements

Besides having the ability of providing all vital husbanding services, the new pier will also provide necessary CHE required to support container vessel offloads. Two rail mounted gantry cranes (Appendix C) will be capable of transiting the entire 950 feet berth. Initially, the pier will require two container handlers (Appendix D) capable of moving 20 and 40 foot containers. These vehicles will support 50,000 pounds and be able to stack two 20 or 40 foot containers. It appears that rail will not be fully utilized since only 60% of the projected 3,200 feet of track will be initially operational. However, improvements in rail usage are anticipated in the future. In the interim, yard tractors (Appendix E) will transport ammunition containers form the pier to the storage facility. When the pier is completely upgraded, the ROK POG will maintain full responsibility for manning the pier and anticipates that much needed CHE training will be provided by MTMC to improve their handling capability of 20 foot as well as 40 foot containers. [Ref. 12:p. 19]

3. Ammunition Holding Facility Requirements

The study also points out that the anticipated offload capacity will be 600 TEUs equivalent to 8,700 short tons (STONS)* and this will present a throughput problem due to the inadequacy of the ROK rail and trucking infrastructure. Current ROK rail and highway structure have limited resources to rapidly support such a high throughput. Thus to meet the high input demand, the study recommends that a large ammunition holding facility be built to store the offload ammunition before its transit.

Table 2 provides a comparison of the future ammunition handling capability of Chinhae to the current handling capability of Naval Weapons Station (NWS) Concord and MOTSU to gain a better understanding of the relative scope of this project. The net explosive weight as indicated below is the maximum total weight of ammunition that is permitted at each facility at any given time based on its overall size and safety regulations.

Facilities / Specifications	Container Handling Capacity	Net Explosive Weight
Chinhae	600 TEUs	1.5 Million Pounds
Concord	200 TEUs	11.2 Million Pounds
MOTSU	600 TEUs	11.2 Million Pounds

Table 2. A comparison of the future ammunition handling capability of Chinhae vs other facilities.
From Ref. [1]

Although Chinhae will have a much smaller net explosive weight threshold due to its dense geographical location, the plan for Chinhae is to equal MOTSU's current container handling capability. Additionally, Chinhae will triple the current capability of

* A short ton is equivalent to 2000 pounds

Concord which can only handle containers when certain breakbulk ships are equipped with self-sustaining container handling gears onboard.

The funding for the overall project is to be assumed by the ROK and the project is estimated to be 40 % complete as of December 1995, with final construction expected to be finished by December 1997. Appendix F provides a complete overview of the improvement plan at Chinhae. [Ref. 5]

The resulting capabilities estimated from planned improvements are substantial. Given the estimated savings of 75% in load and offload time as indicated by MRS, over the past 3 years, it is estimated that total of 181 days could have been saved through use of containerization as illustrated in Table 3 below:

Calendar Year	Actual Breakbulk Days	Proposed Container Days	Days could be Saved
92	92	19	73
93	41	9	32
94	96	20	76

Table 3. Chinhae Ammunition Pier Annual Break vs. Container Loadout Comparison. After Ref. [13]

E. SUMMARY

The significance of the upgrade at Chinhae, ROK cannot be overstated. The ability to transport fully containerized ammunition from CONUS POE, to Chinhae Ammo Pier, POD, is an integral component of U.S. military strategy in the region.

Although it will take a while to fully train the personnel to handle the expected throughput capacity, this task should become easier through time and experience. Clearly, the combined efforts of US-ROK to modernize Chinhae Ammo Pier is a positive step towards fulfilling the goal of Mobility Requirements Study.

IV. CONTAINERIZATION OF AMMUNITION EFFORTS IN THE U.S.

A. INTRODUCTION

According to the findings of Mobility Requirements study (MRS), the DoD is in the process of establishing a plan to upgrade the existing ammunition handling facility in Concord, CA. When this project is completed, it should have the capability to handle and transport ammunition much more efficiently throughout the Pacific region. This chapter describes the significance of the MRS as it relates to the Concord project. It examines the status of the existing facility as well as the efforts that are anticipated to upgrade the facility in the near future. Finally, the future ammunition handling capability of the facility and its potential cost savings are also discussed.

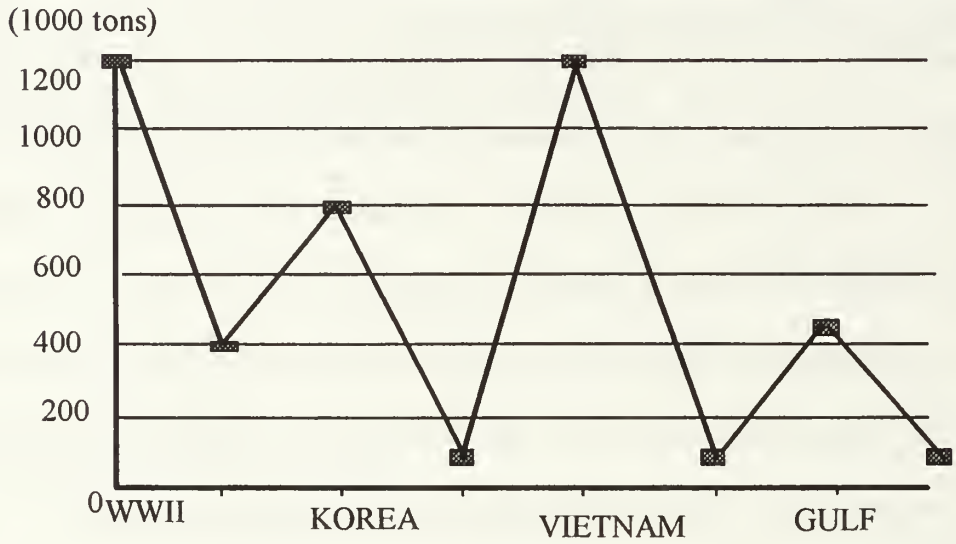
B. CONCORD WEAPONS STATION

1. History

Naval Weapons Station Concord, CA began its national defense role in 1942 as an annex built to supplement the Mare Island Naval Magazine built in 1857. In the next half century, a significant change to its size, mission, and its importance to national defense created the Weapons Station of today, the West Coast Ammunition Ocean Terminal for the Department of Defense. [Ref. 16]

As illustrated in Figure 1, during the World War II, the Vietnam and Korea Wars, the station was the principal port for the transshipment of ammunition to U.S. and allied combat forces. During the Desert Shield /Storm, the station was one of three principal

bulk ammunitions outloading facilities with Concord supplying approximately 30 percent of the explosive ordnance, amounting to more than 400,000 tons. [Ref. 17]



From 1945-1994

Figure 1. NWS Concord Annual Loadouts
From Ref. [17]

2. Location

Naval Weapons Stations Concord (Appendix G) is located approximately 35 miles northeast of San Francisco. Access to the facility is through the San Francisco Bay, the San Pablo Strait and Bay, the Carquinez Strait and the Suisan Bay. Concord is served by the Southern Pacific, Union Pacific and Sacramento Northern railroads which pass through the tidal area. State Highway 4 provides access to the station, and connects to all west coast freeway systems.

3. Mission

Naval Weapons Station Concord has the following key missions [Ref. 17]:

1) Maintain and operate a DoD explosive ordnance outloading and transshipment facility.

2) Maintain and operate an expendable ordnance storage and receipt, segregation and issue facility.

3) Maintain intermediate level maintenance for ordnance and other material assets.

4. Facility

Naval Weapons Station Concord has 3 full loop piers with 6 berths (Appendix H) and a barge pier. The facility can provide service for up to nine combatant and military explosive supply vessels at the same time. Pier three which has the largest capacity can handle a vessel loaded to up to 11.2 million pounds of net explosive weight (NEW) and the barge pier also has the capability of handling 750,000 pounds of NEW. As the Pacific's largest ordnance handling facility, it has the capacity to simultaneously handle a total of 24 million pounds of NEW and 63,000 tons of ordnance storage capacity. [Ref. 18]

Primarily being a breakbulk terminal, the existing facility has the infrastructures required to support outstanding breakbulk ammunition operations but limited container handling capability. Table 4 illustrates the characteristics and current ammunition handling capacity of the port.

Pier # / Characteristics	Pier 2	Pier 3	Pier 4	Barge Pier
Length	1180'	1220'	1220'	337'
# of Berth	2	2	2	1
NEW (in lb.)	7 million	11.235 million	6 million	750K

Table 4. Characteristics of NWS Concord Piers.
After Ref. [19]

C. DISCUSSION

As previously mentioned, the Mobility Requirements Study identified the need for a west coast container port as a major component of strategic mobility. The most ideal proposal currently being considered by DoD is upgrading the existing facility of Naval Weapons Station Concord into a container handling capable facility. The objective is to achieve a maximum capability of handling 600 TEUs per day, which will equal the anticipated handling capacity of Chinhae Ammunition Pier upon completion of its upgrade.

Currently, Concord's breakbulk facility at best can handle about 200 TEUs per day without utilizing modern container handling methods. The containers can be loaded onto a ship either by the floating cranes which are maintained at the pier or they can be loaded by ship's own cranes, in case of a self-sustaining vessel. [Ref. 20] However, these container handling methods are neither very efficient nor very favorable, since they do not meet the throughput requirement identified by the MRS.

Initially, the MRS recommended that Concord's capabilities be increased to equal MOTSU, however the original cost estimate to complete this transformation was over $126 million. This total included pier upgrades, container cranes, container chassis, tractors, straddle carriers, etc. , as well as increased holding area to store 1000 containers. [Ref. 21:p. 23] This would turn NWS Concord into a fully functioning containerized ammunition port. Given the large price tag, this upgrade was turned down.

As a result, a new $57 million plan was developed and proposed. The itemized list of the expenditures for NWS Concord containerization project is as follows:

Ordnance Operations Bldg.	$3.5M
Upgrade to Pier 3	$12.3 M
Container Cranes and Handling Equipment	$14.4M
Rail/Truck Explosive Holding Yard	$20.0M
Auxiliary Equipment	$ 2.2M
Union Pacific Right-of-way	$ 1.6M
Environmental	$ 3.0M
TOTAL	$57.0M

The plan was also developed under the following assumptions:

1) An adequate number of DoD and commercial trucks and chassis would be available for moving containers on station.

2) Properly configured truck and rail assets are available to move the containers to Concord.

3) Just-in-time delivery is possible, to minimize the holding area required.

4) No container stuffing facilities would be required at Concord. All containers would arrive ready for transport by ship.

5) The rate of 500+ container per day would be required for only a brief period. [Ref. 22:p. 6]

Although this new plan didn't fully match the overall capability of MOTSU, because of NWS Concord's excellent rail and truck access as well as its high NEW limit, it was determined that NWS Concord could possibly handle the large flow of containers required of a container ammunition facility similar to MOTSU.

The preliminary design study prepared by Naval Facilities Engineering Command [Ref. 3] outlined the technical requirements which were necessary to upgrade the existing

facility in Concord. According to the study, in order for NWS Concord to carryout an additional mission of west coast terminal for container ammunition transshipment, an upgrade to pier 3 was necessary to convert it into a container handling pier. Additionally, the study indicated the following:

1) Acquire large container cranes.

2) Construct container storage pads.

3) Procure support equipment.

4) Construct support facilities.

In summary, the study revealed that the conditions of the current infrastructure for receiving and processing its capacity was inadequate and that merely adding the cranes necessary to achieve a handling rate of 600 containers a day would not be sufficient to handle the large flow of containers. Therefore, the study recommended the following major projects and they will be implemented in the future plan:

1) Upgrade Ammunition Pier 3 to accommodate two 40-ton capacity container cranes.

2) Construct Rail and Truck Explosive Holding Yard, providing 8 holding pads, with additional rail interchange, inspection and unloading capacity.

3) Construct administration building for waterfront operations.

4) Acquisition of Union Pacific Rail right-of-way around the facility.

D. ISSUES

The preliminary design study, similar to the one conducted by MTMCTEA for Chinhae, also utilized C9-M class container vessel as a guide for pier dimension requirements. Although the exact specifications and the details of the overall project are

still being developed, it appears that the width of Pier 3 will be extended by 15 feet and become 100 feet wide, but the overall length of the pier is expected to remain the same at 1220 feet. The 40-ton container cranes are planned to be stowed at each end of the pier. With the 1200 feet crane girder and the container cranes stowed at each end, this will be approximately 1000 feet of pier and this space could be utilized for breakbulk operation as well, when the cranes are not in use. Therefore, this dual handling capability should add much versatility to NWS Concord's existing operation. [Ref. 14]

However, there is one major limitation to NWS Concord's location. Along the 39 mile approach to the Concord facility to Concord from San Francisco, there are two 135 feet railroad bridges which limit C9-M types of container vessels capable of utilizing the port. Less than half of the 93 registered U.S. flagged container vessels can clear the bridges and depending on the availability of smaller container vessels, this presents a serious, potential problem. [Ref. 23:p. 4]

In order to alleviate this problem, Army Corps of Engineers are currently studying the feasibility of dredging the channel to overcome the height restriction as well as dredging beneath the pier to increase its current berth depth from 35 feet to 42 feet in order to accommodate a fully loaded C9-M vessel, having a draft of 38 feet. However, if these options are not viable, there may be an alternate possibility of using foreign flagged vessels. An estimated 721 of the 1535 foreign vessels meet the height restrictions of the approach to Concord. [Ref. 23:p. 5] Many foreign flagged vessels have been utilized in numerous recent conflicts to transport U.S. military cargo and proved to be quite reliable.

It is anticipated that in 1999, when Pier 3 is fully upgraded with the container handling capability, approximately 20 lifts can be completed per hour. Based on this information, a fully loaded C9-M vessel with a capacity of 18,995 STONS could be offloaded in only 2 days by the two 40-ton container cranes. A typical breakbulk vessel which has a much smaller load capacity on average takes approximately 9 days to offload its cargo.[Ref. 1] Table 5 below compares ammunition handling capabilities container and breakbulk vessels and clearly illustrates the enormous advantages of container versus breakbulk operations.

Characteristics / Ship Type	Capacity	Offload Days
Container Ship	18,995 STONS	2
Breakbulk Ship	7,408 STONS	9

Table 5. Breakbulk and Containership Comparison
After Ref. [1]

Furthermore, based on the MRS' general rule that 75% less time is required to load/offload a container vessel, the number of days that could have been saved by container vs breakbulk method for the calendar year 1992 through 1994 at NWS Concord is illustrated in Table 6 below.

Calendar Year	Actual Breakbulk Days	Proposed Container Days	Days Could Be Saved
92	603	151	**452**
93	122	31	**91**
94	77	20	**57**

Table 6. NWS Concord Annual Breakbulk vs. Container Loadout Comparison.
After Ref. [20]

These analyses indicate, the significance of the upgrade at NWS Concord cannot be over emphasized.

E. COST/BENEFIT ANAYSIS

Along with the benefits of the time savings associated with ammunition containerization, there are additional cost/benefits associated with ammunition containerization. If a cost comparison could be done between a breakbulk and container operation, it should be clear that cost savings through container operation would be quite significant, since breakbulk operation requires much more manpower due to multiple handling requirements of ammunition as previously mentioned and also ammunition throughput being much lower. Based on the author's experience, about 60 TEUs equivalent units of ammunition can be handled through breakbulk operation on a daily basis. Unfortunately, ammunition handling cost data was not available regarding breakbulk from NWS Concord. However, using a similar cost comparison done by NWS Concord between working a self sustaining container ship versus modern container operation per day, the following data was collected :

# Personnel / Skill Level	Self Sustaining	Container Operation
General Foreman	2	2
Pier Supervisor	2	2
Leader	8	8
Winchman	16	8
Stevedore	64	64
Office Personnel	4	4
Cargo Handler	2	2
Cargo Scheduler	2	2
Rigger	4	4
Truck Drivers	16	20
Rail Workers	24	48
Traffic Controller	2	2
Total	146	166

Total Hours	1460 hrs	1660 hrs
Total Cost	$119,516	$135,888
Capacity	200 TEU	600 TEU
Cost/Container	$598	$228

Table 7. Cost Comparison between Self Sustaining vs. Container Operation
From Ref. [24]

As previously mentioned, self sustaining container operation consists of handling containers by utilizing floating cranes or ship's own cranes.

The data was based on what the average self sustaining and container operation currently requires. Therefore, 200 TEUs were assumed to be handled by a self sustaining operation and 600 TEUs by two container cranes respectively. Additionally, each shift was assumed to be 10 hours long and $81.86 was utilized as the average pay rate per man hour.

Based on the above information, it is evident that although the total cost of container operation exceeds the self sustaining operation, the cost per container by container operation is only about 40% of self sustaining operation or $370 ($598 - $228) less than the cost of self sustaining operation. This cost reduction per container for container operation obviously is as a result of a higher container throughput. Clearly, the cost savings of the container operation will be much more significant if a total of 40,000 TEUs per month is assumed to be utilized in a major regional conflict.

Although the modernization project for NWS Concord will be costly due to its high initial capital investment, in the long run, the benefits should certainly outweigh the

costs. Using three hypothetical scenarios with the cost comparison data from Table 7, (1) if a major regional conflict is assumed to occur every 10 years with required TEUs of 40,000 per month, (2) if a multiple major regional conflict is to take place every 25 years with a required TEUs of 70,000 per month, and (3) normal peacetime operation with a required TEUs of 1,500, the break-even point of the investment can be achieved through the following equation:

$$\text{\# of month to break even} = \frac{\text{total capital investment.}}{\text{(savings per container by container Ops vs self sustaining) * (\# of containers moved per month)}}$$

Using the equation then,

Scenario (1): Single MRC every 10 years = $\frac{\$57,000,000}{\$370 * 40,000}$

Scenario (2): Multiple MRC every 25 years = $\frac{\$57,000,000}{\$370 * 70,000}$

Scenario (3): Normal Peacetime Operation = $\frac{\$57,000,000}{\$370 * 1,500}$

For scenario (1), break-even point can be reached in 3.85 months and for scenario (2), only 2.2 months, and 102.7 months for scenario (3), respectively neglecting present value or capital discount in the calculations. However, in reality, the break-even point should be reached much quicker because cost savings per container by container operation versus breakbulk is much higher; these break-even points illustrate potential cost savings of container operation assuming worst case scenarios. Therefore, based on these break-even analyses, it should be clear that the benefits of the modern container operation will significantly outweigh the costs and the modernization at NWS Concord must not be overlooked.

F. SUMMARY

It is possible to utilize MOTSU as the POE to transport ammunition to the Pacific, however from a logistics stand point, this is not desirable in time of a war because of longer travel time. Therefore, Naval Weapons Station Concord is and should remain to be major ordnance corridor to the Pacific.

Although there are some details yet to be worked out to resolve some potential problems, such as bridge clearance, the overall plan should nicely execute the recommendations of the MRS. When NWS Concord has the added capability to handle containers as well as breakbulk like Chinhae Ammo Pier, this will not only cut down the handling time significantly but it will also allow tremendous flexibility and cost savings through its overall operation.

V. CONCLUSIONS AND RECOMMENDATIONS

Today, in order to protect vital U.S. interests throughout the world, future U.S. military strategy should continue to mandate that logistical planners adopt containerization as the primary mode for transporting ammunition. If the world becomes more prone to threats by hostile forces, perhaps in a multiple or simultaneous major regional conflicts, the ability to respond quickly to opposition will become most important. Although roll-on/roll-off vessels are ideal for rapid deployments, sustained conflicts must be supported by quantities of material unsuitable for these types of ships. Because the commercial maritime industry is predominantly composed of container vessels, rendering breakbulk shipping virtually is obsolete, it is logical to assume that containerization must be implemented without delay. The limited potential for supporting a major regional conflict, as outlined in the MRS, highlights the need for rapid change in ammunition handling operations.

Clearly, the link between the upgraded facilities at Chinhae and Concord is crucial to the success of the MRC-W scenario and will bring about many benefits to the U.S. DoD. From logistics stand point, the reduction in travel time due to containerization of ammunition will significantly reduce the stock pile of ammunition in Korea and this has many associated benefits. First, because DoD's level of ammunition safety stock in Korea can be reduced as transportation service is improved via containerization, inventory management can be more optimally conducted. Second, containerization of ammunition will improve customer service level as ammunition can be transported more rapidly. Third, the overall effect of ammunition containerization will improve readiness posture in the

Pacific region as container ships are faster and have larger loading capacity than breakbulk ships; containerization will eliminate unnecessary ammunition handling thus expediting supply to the forces in need.

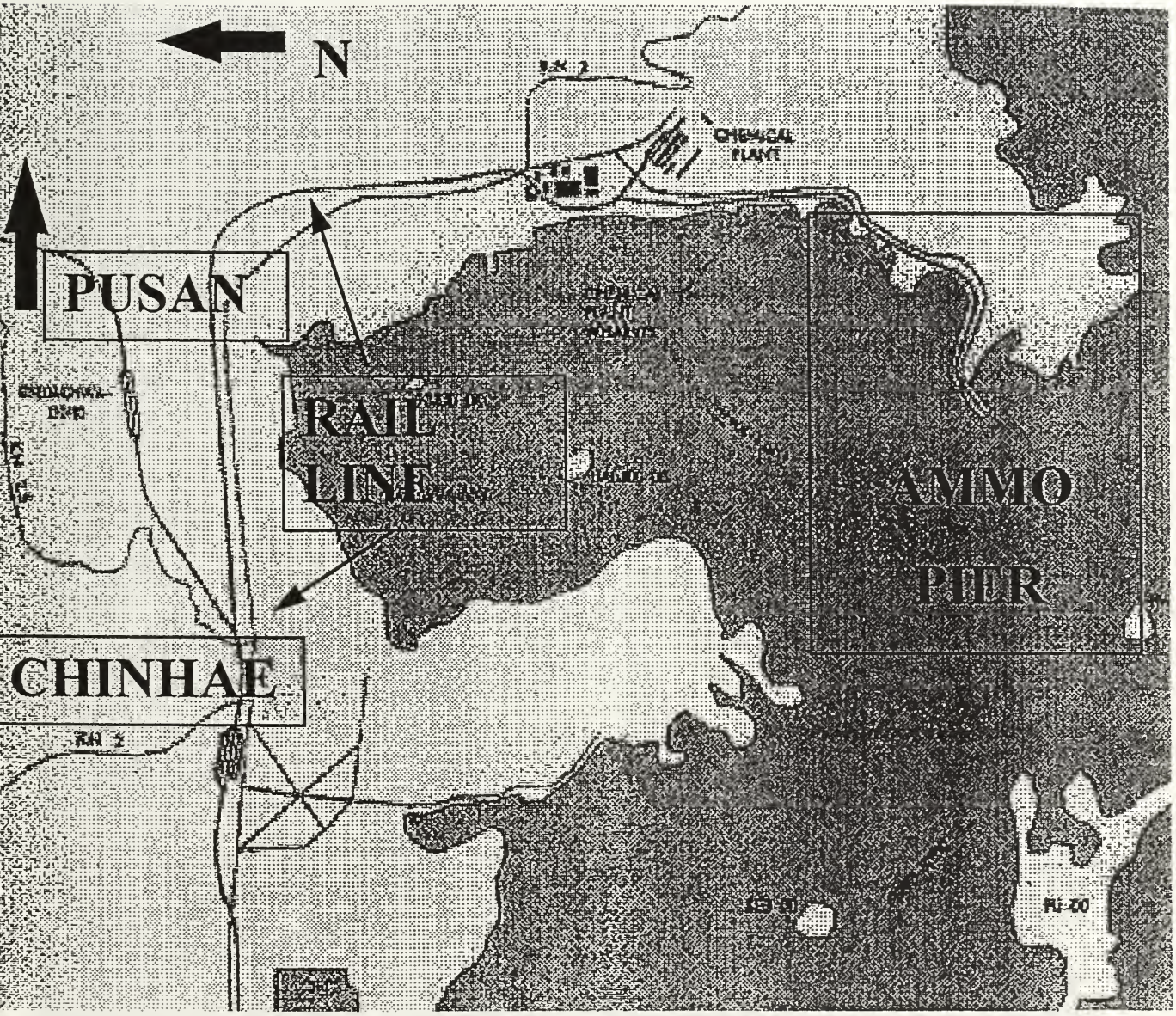
Although the modernization projects are costly, in order to meet the operational tempo required by MRS, they are absolutely needed. The enhanced facilities will most successfully satisfy the necessary throughput requirement. Additionally, the improved facility at Chinhae and Concord will produce two significant cost benefits. First, containerization of ammunition will reduce holding cost as the level of safety stock is reduced. Second, the cost per container in container handling operation will also be reduced.

As military personnel and equipment are reduced from overseas bases, the role of military sealift will become more significant in order to execute all of its missions, and containerization will play a vital role. Capability to handle containers and having proper container handling equipment at points of embarkation and debarkation are very crucial as witnessed by the TURBO CADS Exercise and the Desert Storm/Desert Shield conflict. In order to obtain maximum efficiency through the use of containerization, the military must work towards utilizing commercial assets that are readily available now and in the future. DoD should also look into the possibility of establishing container handling facilities at all overseas installations where the U.S. military presence is dominant in order to implement containerization of ammunition to the fullest extent possible.

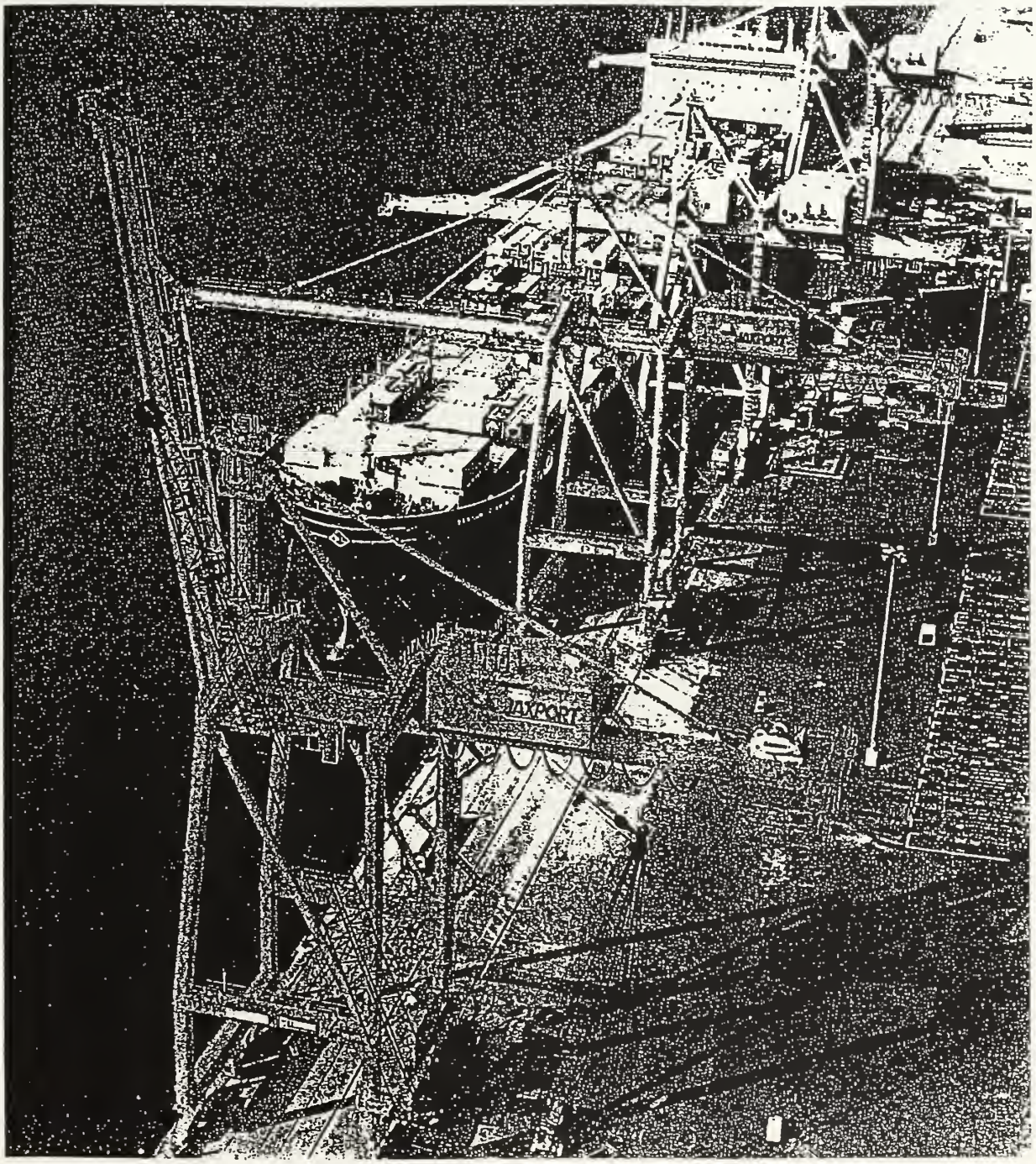
APPENDIX A. LIST OF ACRONYMS

CADS	Containerized Ammunition Distribution System
CHE	Container Handling Equipment
CONUS	Continental United States
DOD	Department of Defense
FSS	Fast Sealift Ship
ISO	Internation Standards Organization
MARAD	Maritime Administration
MOTSU	Military Ocean Terminal Sunny Point
MRC-E	Major Regional Conflict-East
MRC-W	Major Regional Conflict-West
MRS	Mobility Requirements Study
MTMC	Military Traffic Management Command
MTMCTEA	Military Traffic Management Command Transportation Engineering Agency
MV	Motor Vessel
NEW	Net Explosive Weight
NWS	Naval Weapons Station
OCNUS	Out of Continental United States
POD	Port of Debarkation
POE	Port of Embarkation
ROK	Republic of Korea
RO/RO	Roll on/Roll off
RRF	Ready Reserve Force
SALS-K	Single Ammunition Logistics System-Korea
SMES	Special Middle East Shipping
STONS	Short Tons
TEU	Twenty-Foot Equivalent Unit
USCINPAC	United States Commander-in-Chief Pacific
USFK	United States Forces Korea
USPACOM	United States Pacific Command

APPENDIX B. MAP OF CHINHAE AMMUNITION PIER

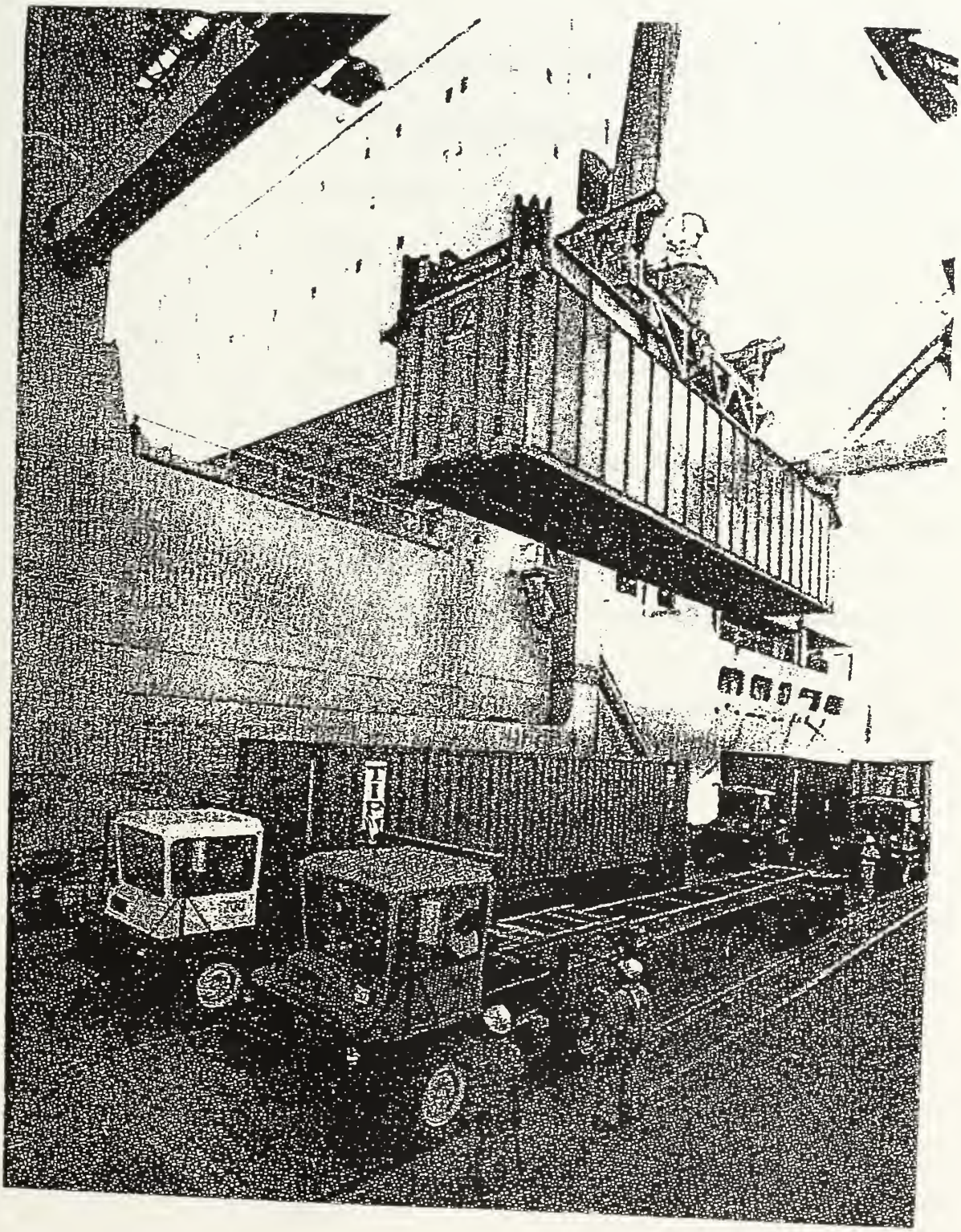


APPENDIX C. GANTRY CRANES



APPENDIX D. CONTAINER HANDLING EQUIPMENT

APPENDIX E. YARD TRACTORS



APPENDIX F. IMPROVEMENT SPECIFICATIONS, CHINHAE AMMUNITION PIER

The following are the proposed specifications for the Ammunition Facility at Chinhae.

Pier Specifications

Total Length	1,050 feet
Width	150 feet
Berth Length	950 feet
Deck Strength	1,000 pounds per square foot

Container Handling Equipment Required

2 container cranes capable of lifting one 20, 40, 45 or two 20 foot containers, each rated at 112,000 pounds minimum capacity

2 container handlers capable of double stacking both 20 and 40 foot containers, minimum lift capability of 50,000 pounds

Yard tractors and chassis capable of moving 20 and 40 foot containers from the pier to the ammunition holding facility

Ammunition Holding Facility

1.5 million pound NEW maximum, waiverable to 3 million pounds

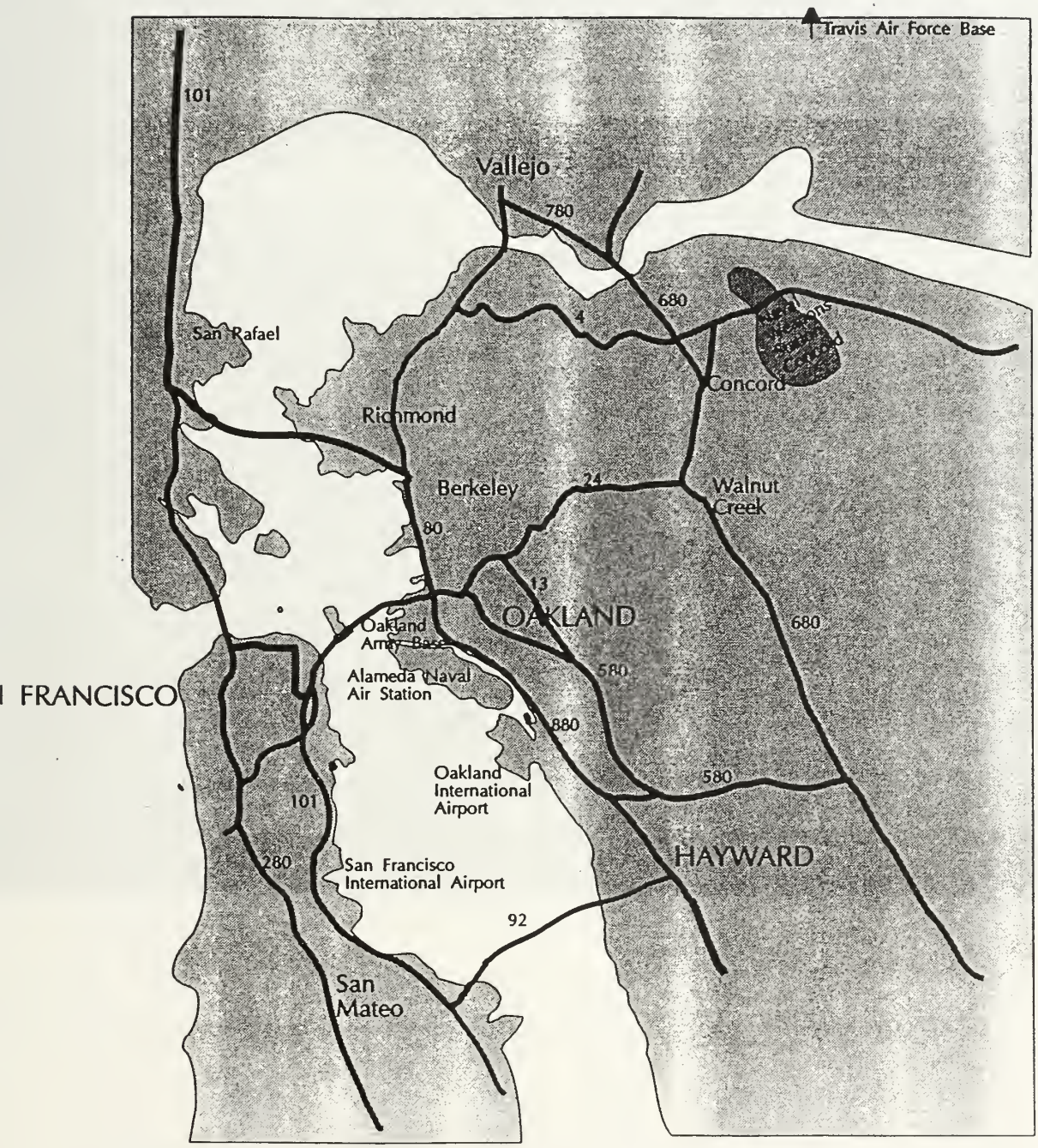
550 TEUs storage capability

2 Ammunition holding modules / 6 Individual pads per module

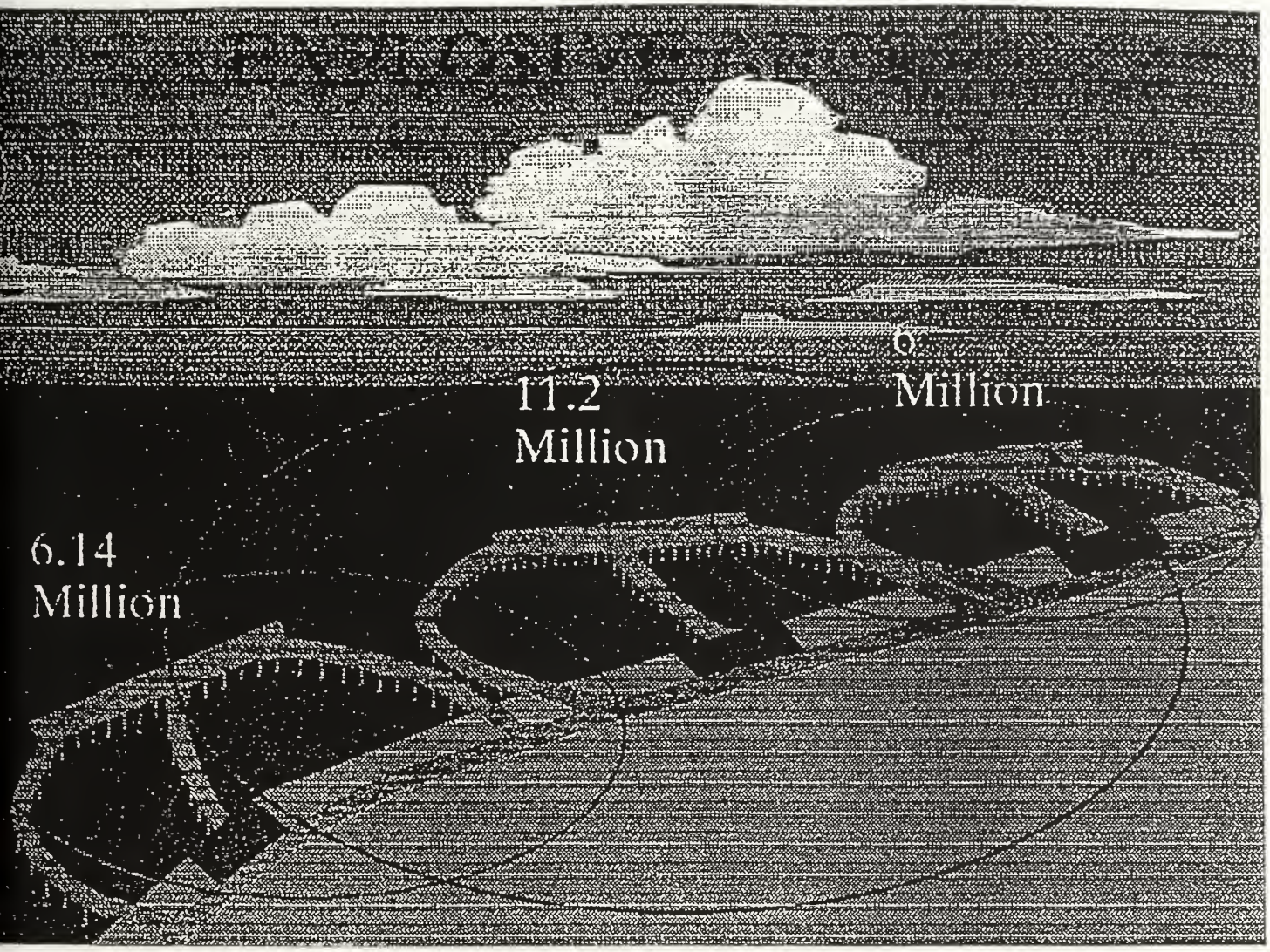
48 TEUs capacity per holding pad

Source: Military Traffic Management Command, Transportation Engineering Agency

APPENDIX G. MAP OF NAVAL WEAPONS STATION CONCORD



APPENDIX H. NAVAL WEAPONS STATION CONCORD PIERS



LIST OF REFERENCES

1. Joint Chiefs of Staff, *Mobility Requirements Study, Volume I*, Washington, DC, 23 January 1992.

2. National Defense Transportation Association, *Wheels, Wings and Rudders*, San Francisco Bay Area Chapter, January 1996.

3. United States Transportation Command, *Containerized Munitions Exercise Turbo CADS 1994 After Action Report*, Scott Air Force Base, IL.

4. U.S. Army Belvoir RD&E Center, *1992 Container System Hardware Status Report*, Report Control Symbol DD-M(A) 1592, Fort Belvoir, VA.

5. Department of Defense Directive 4500.37, *Management of the DoD Intermodal Container System*, April 2, 1987.

6. Rost, R. F., Addams, J.F. and Nelson, J.J. *Sealift in Operation Desert Storm/ Desert Shield: 7 August 1990 to 17 Feburary 1991, (CRM 91-109)*, Center for Naval Analyses, Alexandria, VA, May 1991.

7. Corsano, S.E. *Ammunition Containerization: A Review of Current Efforts*, Master's Thesis, Naval Postgraduate School, Monterey, CA, March 1993.

8. Center for Naval Analysis, *Sealift in Operation Desert Shield/Desert Storm: 7 August 1990 to 17 February 1991*, CRM 91-109, Alexandria, VA, May 1991.

9. Department of Defense, *Conduct of the Persian Gulf War-Final Report to Congress*, April 1992.

10. Research and Special Programs Administration, U.S. Department of Transportation, *Issues Related to Ammunition Delivery During Operation Desert Storm/Desert Shield - Version 1*, October 23, 1992.

11. Morse, John. *The RRF in Operation Desert Storm: A First Look*, Naval War College Report, May 1994.

12. Godwin, S.G. & Compton, R.L., Concept plan for *Container Ammunition Pier Chinhae, Korea*, Military Traffic Management Command, Transportation Engineering Agency (SE 92-3c-38), Newport News, VA, July 1992.

13. Interview between Chon U-Hong, Military Sealift Command Office, Korea, and the author, 7 May 1995.

14. Moffatt & Nichol, *Basic Design Upgrade to Ammunition Pier 3 Naval Weapons Station Concord, CA*, Naval Facilities Engineering Command, Engineering Field Activity-West, San Bruno, CA, June 1995.

15. Interview between LT Kissel USN, Military Sealift Command Office, Korea, and the author, 8 May 1995.

16. *Naval Weapons Station Concord Brochure*, Concord, CA, 17 September 1991.

17. Naval Weapons Station Concord, Command Briefing notes, Concord, CA.

18. Naval Weapons Station Concord, *West Coast Container Vessel Support System*, upgrade proposal briefing notes, Concord, CA.

19. Naval Weapons Station Concord, *Station Facts*, briefing notes, Concord, CA.

20. Interview between K. Yocum, Naval Weapons Station Concord, CA and the author, 8 December 1995.

21. Naval Weapons Station Concord, *West Coast Ammunition Container Vessel Support System*, by H. Rouhafza and K. Yocum, Concord, CA.

22. Naval Weapons Station Concord, *West Coast Ammunition Container Vessel Support System - Harbor Crane Option*, by H. Rouhafza and K. Yocum, Concord, CA, January 1993.

23. Schaible, R.A. , Weiss, J.A. and Fortenberry, H.C. *Army Requirements for a West Coast Ammunition Port, Afloat Prepositioning Maintenance Facility, and Watercraft Maintenance Facility,* (AR105RD1), Logistics Management Institute, Bethesda, MD, September 1993.

24. Telephone FAX Transmission from Karl Yocum, Business Manager, Naval Weapons Station Concord, CA, 7 March 1996.

INITIAL DISTRIBUTION LIST

	No. Copies
1. Defense Technical Information Center 8725 John J. Kingman Rd., STE 0944 Ft. Belvoir, VA 22060-6218	2
2. Dudley Knox Library Naval Postgraduate School 411 Dyer Rd. Monterey, CA 93943-5101	2
3. Professor Keebom Kang SM/Kk Naval Postgraduate School Monterey, CA 93943-5002	1
4. Professor Susan Hocevar SM/Hc Naval Postgraduate School Monterey, CA 93943-5002	1
5. Mr. Chon, U-Hong Military Sealift Command Office, Korea Unit 15175 APO AP 96259-0264	1
6. Mr. Karl Yocum, Code - 05C Business Development Office Naval Weapons Station Concord, CA 94625-5000	1
7. LT Chong K. Kim, USN Officer in Charge Personnel Support Activity Detachment North Bay San Francisco 250 Executive Way Oakland, CA 94625-5000	2

DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY CA 93943-5101

DUDLEY KNOX LIBRARY
3 2768 00322904 8